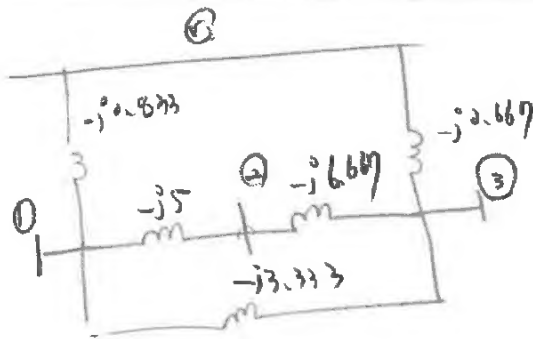


2019 학년도 제 학기 성적평가지

교과목명		시험일자	20 . . .	담당교수	(서명)	성적	
강좌번호		학과		학번		성명	

1.



$$(A) Y_{bus} = \begin{bmatrix} -j9.166 & j5 & j3.333 \\ j5 & -j11.667 & j6.667 \\ j3.333 & j6.667 & -j10.111 \end{bmatrix}$$

(B) 2-3 선로 단선

$$Y_{bus} = \begin{bmatrix} -j9.166 & j5 & j3.333 \\ j5 & -j5 & 0 \\ j3.333 & 0 & -j4 \end{bmatrix}$$

(C)

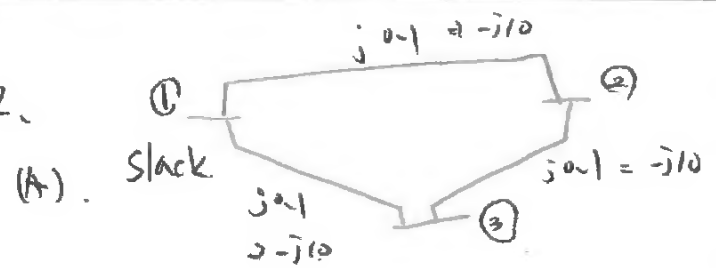


$$Y_{bus} = \begin{bmatrix} -j9.023 & j6.19 \\ j6.19 & -j6.857 \end{bmatrix}$$

$$(D) Z_{bus} = -0.1016 \begin{bmatrix} -j6.857 & -j6.19 \\ -j6.19 & -j9.023 \end{bmatrix}$$

$$Z_{bus} = \begin{bmatrix} j0.6967 & j0.6289 \\ j0.6289 & j0.9135 \end{bmatrix}$$

2.



$$Y = \begin{bmatrix} -j20 & j10 & j10 \\ j10 & -j20 & j10 \\ j10 & j10 & -j20 \end{bmatrix}$$

$$B = \begin{bmatrix} -20 & 10 \\ 10 & -20 \end{bmatrix}$$

$$(b) \theta = B^{-1} P$$

$$B^{-1} = \frac{1}{300} \begin{bmatrix} -20 & 10 \\ 10 & -20 \end{bmatrix}$$

$$P_2 = \frac{200}{100} = 2$$

$$\begin{bmatrix} \theta_2 \\ \theta_3 \end{bmatrix} = \frac{1}{300} \begin{bmatrix} -20 & 10 \\ 10 & -20 \end{bmatrix} \begin{bmatrix} 2 \\ 0 \end{bmatrix}$$

$$\begin{bmatrix} \theta_2 \\ \theta_3 \end{bmatrix} = \begin{bmatrix} -0.1333 \\ -0.0667 \end{bmatrix} \text{ (rad)}$$

(C)

$$P_{12} = \frac{1}{x_{12}} (\theta_1 - \theta_2)$$

$$= \frac{1}{0.1} (0 + 0.1333) = 1.333 \text{ pu}$$

$$P_{12} = 1.333 \times 100 = 133.3 \text{ MW}$$

3.

$S_{base} = 30 \text{ M} \Rightarrow \text{변환기 기저!}$

$$(A) Z_{base} = \frac{(V_{base})^2}{S_{base}} = \frac{(277 \text{ kV})^2}{30 \text{ M}} = 36.3 \Omega$$

$$Z_{Line}^{pu} = \frac{3 + j15}{36.3} = 0.08 + j0.413$$

(B)

$$X_{G1} = j0.15 \times \frac{30}{20} = j0.225 \text{ pu}$$

$$X_{G2} = j0.1 \times \frac{30}{10} = j0.3 \text{ pu}$$

$$X_T = j0.05$$

$$Z_{TH} = (j0.225 // j0.3) + j0.05 + 0.08 + j0.413$$

$$= j0.1286 + j0.05 + 0.08 + j0.413$$

$$= 0.08 + \cancel{j0.6066} \text{ pu}$$

$$(C) I_{AC(RMS)} = \frac{1}{0.08 + j0.6066}$$

$$= 1.629 \text{ pu}$$

$$(D) Z = 3 \quad \underline{\underline{i_{rms}}}$$

$$i_{rms} = I_{AC} \sqrt{1 + 2e^{-4\pi Z / (R)}} \quad \left(\frac{R}{Z} \right)$$

$$= 1.629 \sqrt{1 + 2e^{-4\pi \times 3 / 17.605}}$$

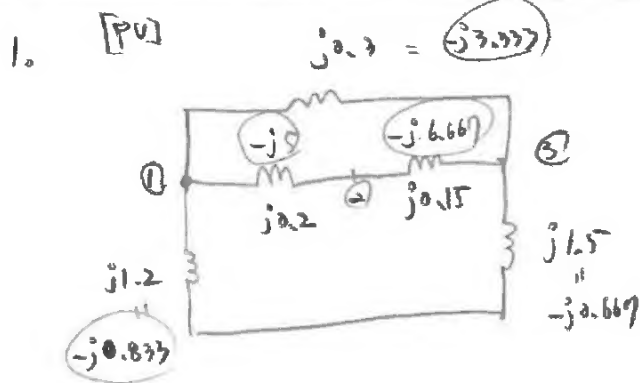
$$= 1.64 \text{ pu}$$

$$I_{rms}(t) = I_{AC} \sqrt{1 + 2e^{-2t/T}}$$

$$= I_{AC} \sqrt{1 + 2e^{-4\pi Z / (R/R)}}$$

20 18 학년도 제 학기 성적평가지

교과목명		시험일자	20 . . .	담당교수	(서명)	성적	
강좌번호		학과		학번		성명	

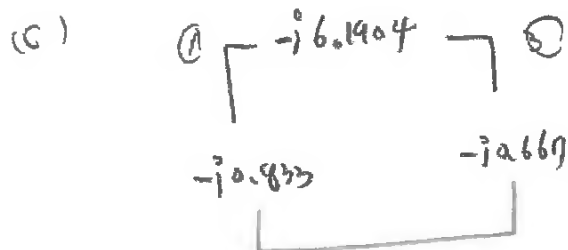


(A),

$$Y_{bus} = \begin{bmatrix} -j6.667 & j5 & j0.333 \\ j5 & -j11.667 & j6.667 \\ j0.333 & j6.667 & -j10.667 \end{bmatrix}$$

(B),

$$Y_{bus} = \begin{bmatrix} -j5.8333 & j5 & j0.8333 \\ j5 & -j11.667 & j6.667 \\ j0.8333 & j6.667 & -j10.667 \end{bmatrix}$$



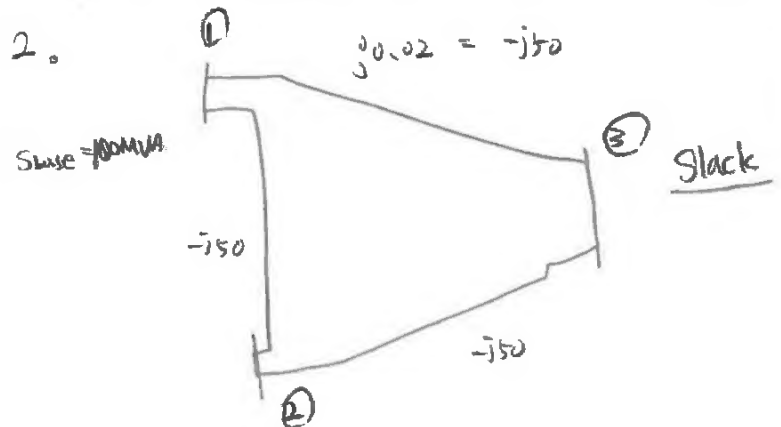
$$Y_{bus} = \begin{bmatrix} -j10.234 & j6.1904 \\ j6.1904 & -j6.8574 \end{bmatrix}$$

(D), $Z_{bus} = Y_{bus}^{-1}$

$$= -0.1016 \begin{bmatrix} -j6.8574 & -j6.1904 \\ -j6.1904 & -j10.234 \end{bmatrix}$$

$$= \begin{bmatrix} j0.6467 & j0.6289 \\ j0.6289 & j0.1136 \end{bmatrix}$$

2.



(A) $Y_{bus} = \begin{bmatrix} -j100 & j50 & j50 \\ j50 & -j100 & j50 \\ j50 & j50 & -j100 \end{bmatrix}$

$$B = \begin{bmatrix} -100 & 50 \\ 50 & -100 \end{bmatrix}$$

(B), $\theta = B^{-1}P$

$$B^{-1} = \frac{1}{7500} \begin{bmatrix} -100 & -50 \\ -50 & -100 \end{bmatrix}$$

$$\begin{bmatrix} \theta_1 \\ \theta_2 \end{bmatrix} = \frac{1}{7500} \begin{bmatrix} -100 & -50 \\ -50 & -100 \end{bmatrix} \begin{bmatrix} +0.4 \\ +0.3 \end{bmatrix}$$

$$\begin{bmatrix} \theta_1 \\ \theta_2 \end{bmatrix} = \begin{bmatrix} -0.0073 \\ 0.0067 \end{bmatrix} \text{ (rad)}$$

(C) $P_{31} = \frac{1}{X_{31}} (\theta_3 - \theta_1)$

$$= \frac{1}{0.02} (0 + 0.0073)$$

$$P_{31} = +0.365 \text{ pu}$$

$$P_{31} = +0.365 \times 100 \text{ M} = +36.5 \text{ MW}$$

3.

$$(A) I_{AC(RMS)} = \frac{V}{Z}$$

$$I_{AC} = \frac{154K \times 1.5}{|1 + j10| \sqrt{5}} = 9289.42 \angle -84.29^\circ$$

$$I_{AC(RMS)} = 9289.42 A$$

(B) $z = 0.5$ cycle DC

$$i_{DC}(t) = - \frac{\sqrt{2} V \sin(\alpha - \theta)}{Z} e^{-t/T}$$

$$i_{DC}(z) = \sqrt{2} I_{AC} e^{-2\pi z / (\frac{L}{R})}$$

$$i_{DC}(0.5) = 9595.46 A$$

(C) CB π cycle I_{rms}

$$I_{rms} = I_{AC} \sqrt{1 + 2e^{-4\pi z / (\frac{L}{R})}}$$

$$= 9289.42 \sqrt{1 + 2e^{-4\pi \times 0.5 / 10}}$$

$$= 9501.166 A$$

$$i_{DC}(t) = - \frac{\sqrt{2} V}{Z} \sin(\alpha - \theta_2) \cdot e^{-t/T}$$

$$I_{DC} = \sqrt{2} I e^{-t/T} = \sqrt{2} I e^{-2\pi T / (\frac{L}{R})}$$

$$I_{AC} \cdot \sqrt{1 + 2e^{-2t/T}} = I_{rms}(t)$$

$$I_{AC} \sqrt{1 + 2e^{-4\pi T / (\frac{L}{R})}}$$

4.

$$(A) I'' = \frac{V_{TH}}{Z_{TH}} = \frac{1}{j0.6969} = 1.4353 pA$$

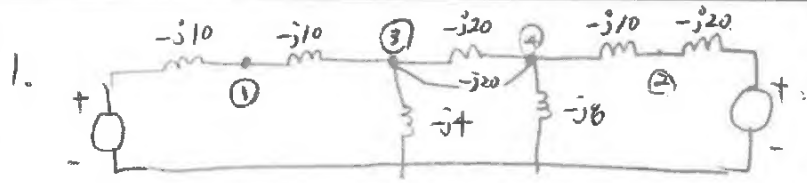
$$(B) V_{LL} = 22.9 kV \quad S_{base} = 1000 kVA$$

$$I_{base} = \frac{1000 k}{\sqrt{3} \times 22.9 k} = 25.21 A$$

$$I'' = 25.21 \times 1.4353 = 36.186 A$$

20 / ? 학년도 제 학기 성적평가지

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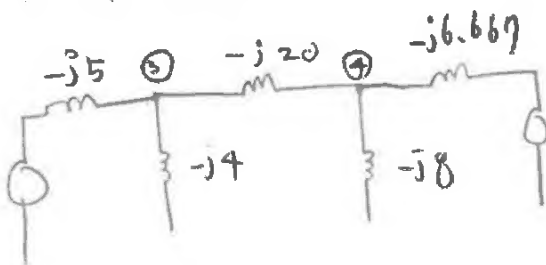
(A) Y_{bus}

$$= \begin{bmatrix} -j20 & 0 & j10 & 0 \\ 0 & -j30 & 0 & j10 \\ j10 & 0 & -j34 & j20 \\ 0 & j10 & j20 & -j38 \end{bmatrix}$$

(B) Y_{bus}

$$= \begin{bmatrix} -j20 & 0 & j10 & 0 \\ 0 & -j30 & 0 & j10 \\ j10 & 0 & -j34 & j20 \\ 0 & j10 & j20 & -j38 \end{bmatrix}$$

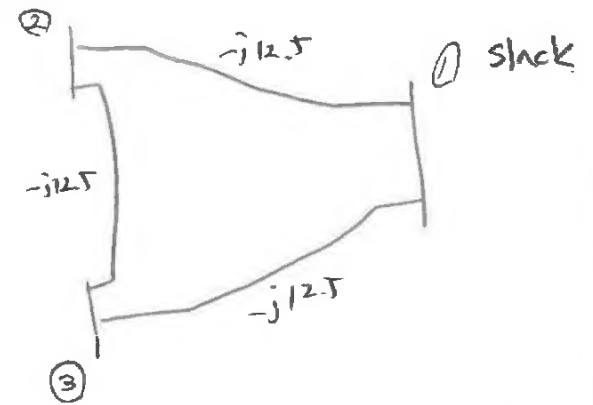
(C) 1, 2 모선 무시.



$$Y_{bus} = \begin{bmatrix} -j24 & j20 \\ j20 & -j34.667 \end{bmatrix}$$

2. $S_{base} = 100 \text{ MVA}$

$$Z_L = j0.08 \Rightarrow Y_L = -j12.5$$



$$(A) Y_{bus} = \begin{bmatrix} -j25 & j12.5 & j12.5 \\ j12.5 & -j25 & j12.5 \\ j12.5 & j12.5 & -j25 \end{bmatrix}$$

$$B = \begin{bmatrix} -25 & 12.5 \\ 12.5 & -25 \end{bmatrix}$$

$$(b) B\theta = P \quad \theta = B^{-1}P$$

$$\begin{bmatrix} \theta_2 \\ \theta_3 \end{bmatrix} = \frac{4}{1075} \begin{bmatrix} -25 & -12.5 \\ -12.5 & -25 \end{bmatrix} \begin{bmatrix} 2 \\ 1.5 \end{bmatrix}$$

$$\begin{bmatrix} \theta_2 \\ \theta_3 \end{bmatrix} = \begin{bmatrix} -0.14667 \\ -0.13333 \end{bmatrix} \text{ (rad)}$$

$$(c) P_{12} = \frac{1}{x_{12}} (\theta_1 - \theta_2) = \frac{1}{0.08} (0.14667)$$

$$P_{12} = 1.833 \text{ pu}$$

$$P_{12} = 1.833 \times 100 \text{ M} = \underline{183.3 \text{ MW}}$$

3. 중성점 전압

154kV, 60Hz

(A)

$$E_n = \frac{\sqrt{C_a(C_b - C_c) + C_b(C_c - C_a) + C_c(C_a - C_b)}}{C_a + C_b + C_c} \times \frac{154k}{\sqrt{3}}$$

$$E_n = 0.00529 \times \frac{154k}{\sqrt{3}} = 470.43V$$

$$= 0.47kV$$

(B) $I_c = WCE = 2\pi \times 60 \times (0.975 + 0.95 + 0.95) \mu \times \frac{154k}{\sqrt{3}}$

$$= 95.026A$$

$P = \frac{I_L - I_c}{I_c} \times 100 = 10$

(5% I_c)

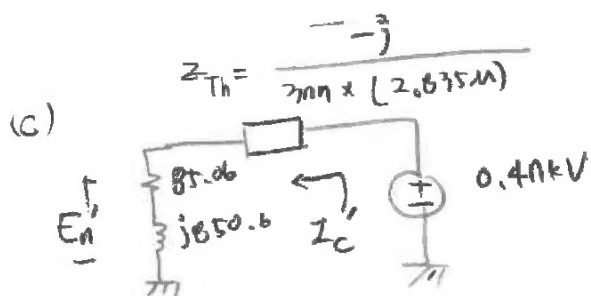
$$I_L = 1.1 I_c = 1.1 \times 95.026$$

$$= 104.529A$$

$$I_L = \frac{E}{X} = \frac{154k}{\sqrt{3}} = 104.529$$

$$X = \frac{154k}{104.529 \sqrt{3}} = 850.6 \Omega$$

$$X = 850.6 \Omega$$



$$I_c' = \frac{470}{85.06 + j850.6 + \frac{-j}{2\pi \times 2.635 \mu}}$$

$$= 3.9077 \angle 44.94^\circ A$$

$$E_n' = (85.06 + j850.6) I_c'$$

$$= 3340.505 \angle 129.2^\circ$$

$$|E_n'| = 3.34 kV$$

4.

(A) $S_{base} = 100 MVA$

$$X_{G1} = j 0.25 \times \frac{100}{50} = j 0.5 pu$$

$$X_{G2} = j 0.25 \times \frac{100}{25} = j 1 pu$$

$$Z_{base} = \frac{(V_{base})^2}{S_{base}} = \frac{(66k)^2}{200 M} = 21.9 \Omega$$

$$Z_T = \frac{j 0.2}{21.9 \Omega} = j 0.00918 pu$$

$$Z_T = j 0.00918 \times \frac{100}{200} =$$

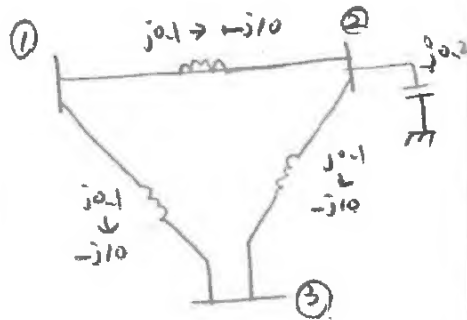
20 / 5 학년도 제 학기 성적평가지

교과목명		시험일자	20 . . .	담당교수	(서명)	성적	
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1.

(A)

$$Y_{bus} = \begin{bmatrix} -j20 & j10 & j10 \\ j10 & -j20 & j10 \\ 110 & j10 & -j20 \end{bmatrix}$$



(B) 커매시터 설치

$$Y_{bus} = \begin{bmatrix} -j20 & j10 & j10 \\ j10 & -j19.8 & j10 \\ j10 & j10 & -j20 \end{bmatrix}$$

(C)

$$P_{32} = \frac{V_3 V_2}{X_{32}} \sin(\theta_3 - \theta_2)$$

$$= \frac{0.99}{0.1} \sin(-2.68 + 1.11)$$

$$= 0.165 \text{ pu}$$

(D) pc power flow

$$B\theta = P$$

$$\begin{bmatrix} -20 & 10 \\ 10 & -20 \end{bmatrix} \begin{bmatrix} \theta_2 \\ \theta_3 \end{bmatrix} = \begin{bmatrix} 2 \\ -0.3 \end{bmatrix}$$

$$\begin{bmatrix} \theta_2 \\ \theta_3 \end{bmatrix} = \frac{1}{200} \begin{bmatrix} -20 & 10 \\ 10 & -20 \end{bmatrix} \begin{bmatrix} 2 \\ -0.3 \end{bmatrix} = \begin{bmatrix} -0.123 \\ -0.0467 \end{bmatrix}$$

$$P_{32} = \frac{1}{0.1} (-0.0467 + 0.123)$$

$$= 0.763 \text{ pu}$$

2. 중성점과기 전압 $200\text{km}, 154\text{kV}$

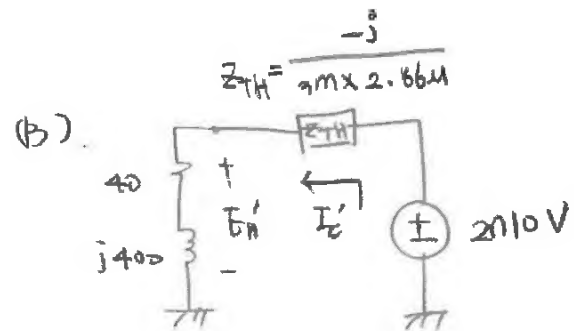
$$(A) C_a = 0.0045 \times 200 = 0.9 \mu\text{F}$$

$$C_b = 0.0048 \times 200 = 0.96 \mu\text{F}$$

$$C_c = 0.005 \times 200 = 1 \mu\text{F}$$

$$E_n = \frac{\sqrt{C_a(C_a - C_b) + C_b(C_b - C_c) + C_c(C_c - C_a)}}{C_a + C_b + C_c} \times \frac{E}{\sqrt{3}}$$

$$E_n = 1110\text{V}$$



$$I_c' = \frac{2110}{40 + j400 + \frac{-j}{111 \times 2.66 \mu\text{F}}}$$

$$= 5.123 \angle 85.66^\circ \text{ A}$$

$$E_n' = (40 + j400) I_c' = 2059.49 \angle 169.95^\circ \text{ V}$$

$$|E_n'| = 2059.49 \text{ V} = 2.059 \text{ kV}$$

✓

3. 60 Hz, 154 kV system

$$R = 0.5 \Omega \quad X = 10 \Omega$$

$$(A) \quad I_{AC(RMS)} = \frac{V}{Z} = \frac{161.7 k}{10.5 + j10} \quad (\sqrt{5})^*$$

$$V = 154 k \times 1.05 \times \frac{1}{\sqrt{3}} = \frac{161.7 k}{\sqrt{3}}$$

$$I_{AC(RMS)} = 9.324 \angle -81.14^\circ \text{ kA}$$

$$I_{AC(RMS)} = 9.324 \text{ kA}$$

(B) $T = 0.5 \text{ cycle}$ i_{dc}

$$i_{dc} = -\frac{\sqrt{2} V_m (\alpha - \theta)}{Z} e^{-t/T}$$

$$= \sqrt{2} I_{AC} e^{-2\pi t / (T)} \quad (\frac{x}{R})$$

$$\frac{t}{T} = \frac{\frac{x}{R}}{\frac{2\pi}{\omega R}} = \frac{Z}{2\pi R} = \frac{2\pi Z}{(x/R)}$$

$$i_{dc} = \sqrt{2} \times 9.324 \text{ kA} e^{-2\pi \times 25 / 20}$$

$$= 11269.34 \text{ A} = 11.269 \text{ kA}$$

(C) CB 동작 i_{rms} (3 cycle)

$$i_{rms} = I_{AC} \sqrt{1 + 2e^{-4\pi t / (x/R)}}$$

$$= 9.324 \text{ kA} \sqrt{1 + 2e^{-4\pi \times 3 / 20}}$$

$$= 10.646 \text{ kA}$$

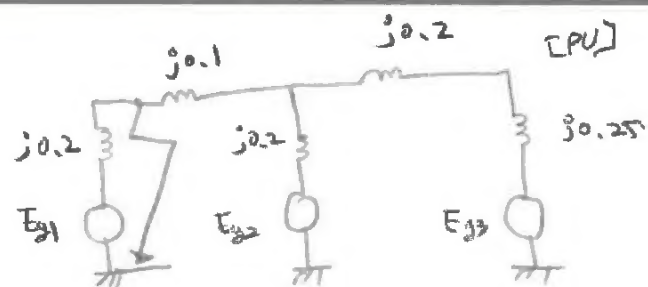
$$(D) \quad x \text{ & } 2 \quad \frac{x}{R} = 5 \quad R = \frac{10}{5} = 2$$

$$I_{AC} = \frac{161.7 k}{(2 + j10) \sqrt{5}} = 9.154 \text{ kA}$$

$$I_{rms} = 9.154 \text{ kA} \sqrt{1 + 2e^{-4\pi \times 3 / 5}}$$

$$= 9.159 \text{ kA}$$

4.



$$S_{base} = 100 \text{ MVA} \quad V_{LL} = 66 \text{ kV}$$

(A) 1회 전력회사 회로상 Z_{TH}

$$(j0.2 + j0.25) \parallel j0.2 = j0.138 \text{ pu}$$

$$Z_{TH} = j0.2 \parallel (j0.1 + j0.138)$$

$$Z_{TH} = j0.109 \text{ pu}$$

$$(B) \quad V_{TH} = 1.05 \angle 0^\circ$$

$$I'' = \frac{V_{TH}}{Z_{TH}} = \frac{1.05 \angle 0^\circ}{j0.109} = 9.633 \text{ pu}$$

$$I_{base} = \frac{100 \text{ M}}{\sqrt{3} \times 66 \text{ k}} = 874.77 \text{ A}$$

$$I''_{act} = 874.77 \times 9.633 = 8.427 \text{ kA}$$

$$(C) \quad Z_{TH}(\omega) = j4.748 \Omega$$

$$Z_{base} = \frac{(V_{LL})^2}{S_{base}} = \frac{(66 \text{ k})^2}{100 \text{ M}} = 43.56 \Omega$$

$$(D) \quad E_a = 1.05 \angle 0^\circ$$

$$I_f = I_f^{(1)} + I_f^{(2)}$$

$$I_f^{(1)} = \frac{1.05 - 1.05}{j0.2} = 0 \text{ A}$$

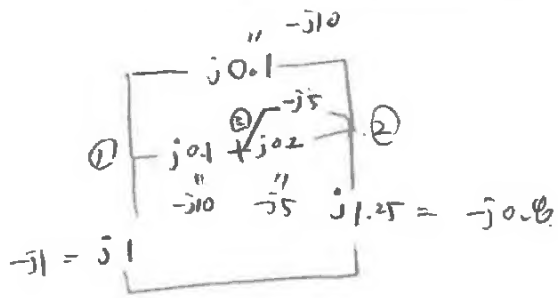
$$I_f^{(2)} = \frac{1.05}{j0.2} = -5.25 j$$

$$I_f = -5.25 j \text{ pu}$$

20 14 학년도 제 학기 성적평가지

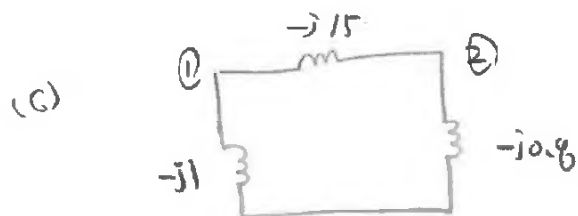
교과목명		시험일자	20 . . .	담당교수	(서명)	성적	
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1.



$$(A) \quad Y_{bus} = \begin{bmatrix} -j21 & j10 & j10 \\ j10 & -j15.8 & j5 \\ j10 & j5 & -j15 \end{bmatrix}$$

$$(B) \quad Y_{bus} = \begin{bmatrix} -j21 & j10 & j10 \\ j10 & -j20.8 & j10 \\ j10 & j10 & -j20 \end{bmatrix}$$



$$Y_{bus} = \begin{bmatrix} -j16 & j15 \\ j15 & -j15.8 \end{bmatrix}$$

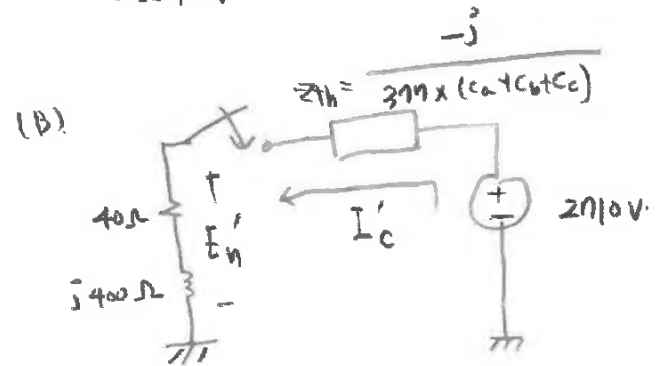
$$\begin{aligned} (b) \quad P_u &= \frac{V_1 V_2}{X_1} \sin(\theta_1 - \theta_2) \\ &= \frac{0.99}{\frac{1}{15}} \sin(\delta) \\ &= \frac{0.99}{\frac{1}{15}} \sin \delta \\ &= 14.85 \sin \delta \end{aligned}$$

2. 중성점 관류전압

$$\begin{aligned} (A) \quad C_a &= 0.0045 \times 200 = 0.9 \mu F \\ C_b &= 0.0048 \times 200 = 0.96 \mu F \\ C_c &= 0.005 \times 200 = 1 \mu F \end{aligned}$$

$$E_n = \frac{\sqrt{C_a(C_b + C_c) + C_b(C_c + C_a) + C_c(C_a + C_b)} \times \frac{154V}{\sqrt{3}}}{C_a + C_b + C_c}$$

$$= 2710 V$$



$$\begin{aligned} I_c' &= \frac{2710}{40 + j400 + \frac{-j}{377 \times 2.86 \mu}} \\ &= 5.123 \angle 85.663^\circ A \end{aligned}$$

$$E_n' = (40 + j400) I_c' = (40 + j400)(5.123 \angle 85.663^\circ)$$

$$= 2059.49 \angle 169.96^\circ V$$

$$|E_n'| = 2059.49 V = 2.059 kV$$



3. 60Hz 전력시스템.

(A) $V_{TH} = 154k \times 1.05 = 161.7kV$

$I_{acrms} = \frac{161.7k}{|2 + j10| \sqrt{3}} = 9154.46A$

(B) $z = 0.5 \text{ cycle}$ Dc 성분 방향 전류

$i(t) = i_{ac}(t) + i_{dc}(t)$

$$= \frac{\sqrt{2}V \sin(\omega t + \theta - \theta_z)}{Z} - \frac{\sqrt{2}V \cos(\theta - \theta_z)}{Z} e^{-t/T}$$

(ac) (dc)

$\therefore i_{dc}(t) = \frac{\sqrt{2}V}{Z} e^{-t/T} \quad (\theta = \theta - \frac{\pi}{2})$

$$\frac{t}{T} = \frac{\frac{\pi}{\omega}}{\frac{1}{f}} = \frac{\frac{\pi}{\omega}}{\frac{1}{\frac{2\pi f}{p}}} = \frac{2\pi Z}{\left(\frac{X}{P}\right)}$$

$i_{dc}(\tau) = \sqrt{2} I_{ac} e^{-2\pi Z / (\frac{X}{P})} A$

$i_{dc}(0.5) = \sqrt{2} \times 9154.46 \times e^{-2\pi \times 0.5 / 5}$
 $= 6906.73A$

(C) CB가 동작하는 $i_{rms}(\tau)$ ($\tau = 3$)

$i_{rms} = I_{ac} \sqrt{1 + 2e^{-4\pi Z / (\frac{X}{P})}}$

$= 9154.46 \sqrt{1 + 2e^{-4\pi \times 3 / 5}}$

$= 9159.72A = 9.159kA$

(D) $X \neq Z \quad \frac{Y}{P} = 10 \quad R = \frac{10}{X} = 1$

$I_{ac} = \frac{161.7k}{|1 + j10| \sqrt{3}} = 9289.42A$

$I_{rms}(3) = 9289.42 \sqrt{1 + 2e^{-4\pi \times 3 / 10}}$
 $= 9501.17 = 9.501kA$

4. $S_{base} = 100M$

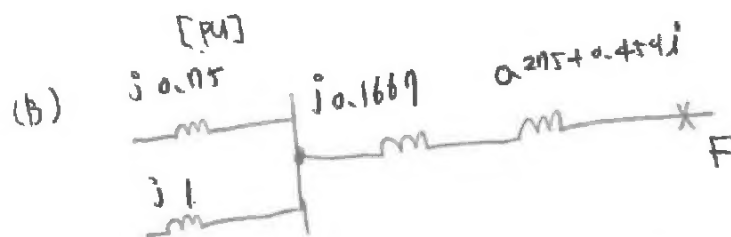
(A) $X_{G1} = 0.15 \times \frac{100}{20} = j0.75 pu$

$X_{G2} = 0.1 \times \frac{100}{10} = j1 pu$

$X_T = 0.05 \times \frac{100}{30} = j0.1667 pu$

$Z_{base} = \frac{V_{base}^2}{S_{base}} = \frac{(37k)^2}{100M} = 10.89 \Omega$

$X_{Line} = \frac{3 + j5}{10.89} = 0.275 + j0.459j$



$Z_{TH} = j0.4286 + j0.1667 + 0.275 + j0.459j$
 $= 0.275 + j1.054j$



(C) 2선 1 (상상)에서 바라본 전계계통

driving point impedance

$Z_{TH} = j0.75 // j1 // (j0.1667 + 0.275 + j0.459j)$

$= j0.429 // 0.275 + j0.625j$

$= 0.0426 + j0.2656j pu$

$Z_{base} = \frac{(11k)^2}{100M} = 1.21 \Omega$

$Z_{TH} = 1.21 \times (0.0426 + j0.2656j)$
 $= 0.0515 + j0.32j \Omega$



(D) 3cycle I'' (관성전류)

$I_f'' = \frac{V}{Z_{TH}} = \frac{1}{0.0426 + j0.2656j} = 3.72 pu$

$I_f'' = 3.72 \times \frac{100M}{\sqrt{3} \times 11k} = 19.524kA$

2013 학년도 제 학기 성적평가지

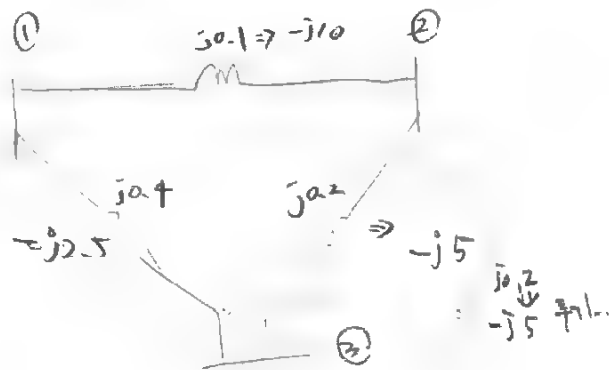
교과목명		시험일자	20 . . .	담당교수	(서명)	성적	
강좌번호		학과	학번		성명		

1.

(A) $\%Z_g = 10\%$, (20 MVA)

$\%Z_{gnew} = 10 \times \frac{100M}{20M} = 50\%$

2



(A) $Y_{bus} = \begin{bmatrix} -j12.5 & j10 & j2.5 \\ j10 & -j15 & j5 \\ j2.5 & j5 & -j17.5 \end{bmatrix}$

(B) $Y_{bus} = \begin{bmatrix} -j12.5 & j10 & j2.5 \\ j10 & -j20 & j10 \\ j2.5 & j10 & -j12.5 \end{bmatrix}$

v

(C)

3. $R = 0.03 \text{ pu}$, $X = 0.1 \text{ pu}$

$V_{base} = 138 \text{ kV}$, $S_{base} = 100 \text{ MVA}$

$I_{base} = \frac{S_{base}}{\sqrt{3} V_{base}}$

(A) $Z_{base} = \frac{(V_{base})^2}{S_{base}} = \frac{(138 \text{ kV})^2}{100 \text{ M}} = 190.44 \Omega$

$Z_{th} = (0.03 + j0.1) \times 190.44 = 5.71 + j19.04j$
 $= 19.88 \angle 73.3^\circ$

(B) $I_{AC(rms)} = \frac{1}{|0.03 + j0.1|} = 9.578 \text{ pu}$

$I_{AC(rms)}^A = 9.578 \times I_{base} = 4007.15 \text{ A}$

$I_{base} = \frac{100 \text{ M}}{\sqrt{3} \times 138 \text{ kV}} = 418.77 \text{ A}$

(C) $T = \frac{L}{R} = \frac{X}{\omega R} = \frac{X}{2\pi f R}$
 $= \frac{0.1}{2\pi \times 0.03} = 8.84 \text{ msec}$

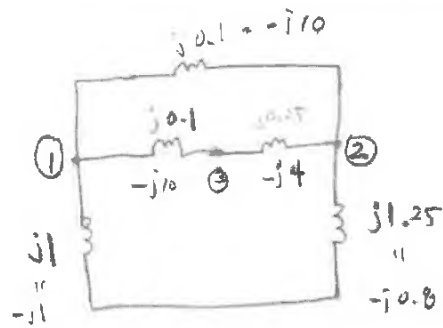
(D) $I_{rms} = I_{AC} \sqrt{1 + 2e^{-4\pi \times 0.5 / R}}$
 $= 4007.15 \sqrt{1 + 2e^{-4\pi \times 0.5 / R}}$
 $= 4575.3 \text{ A}$

(E) $I_{rms(3)} = 4007.19 \text{ A}$

20 / 2 학년도 제 학기 성적평가지

교과목명		시험일자	20 . . .	담당교수	(서명)	성적	
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1.



$$(A) Y_{bus} = \begin{bmatrix} -j21 & j10 & j10 \\ j10 & -j14.8 & j4 \\ j10 & j4 & -j14 \end{bmatrix}$$

$$(B) P_{13} = ? \quad V_1 = 1 \angle 0^\circ, \quad V_3 = 1.05 \angle -\delta$$

$$P_{13} = \frac{V_1 V_3}{x_{13}} \sin(\theta_1 - \theta_3) = \frac{1 \cdot 1.05}{0.1} \sin(\delta) \text{ pu}$$

$$(C) P_{13} = \frac{1.05}{0.1} \sin(\delta) = 0.6 \text{ pu}$$

$$\sin \delta = 0.057 \quad \therefore \delta = \sin^{-1} 0.057 = 3.28^\circ$$

$$(D) Z_{23} = 0.25 / 0.25 = 0.125$$

$$Y_{23} = -j8$$

$$Y_{bus} = \begin{bmatrix} -j21 & j10 & j10 \\ j10 & -j18.8 & j8 \\ j10 & j8 & -j10 \end{bmatrix}$$

$$3. \text{ 전압강하 } A=0.01 \text{ pu} \quad x=0.1 \text{ pu}$$

$$\text{전압강하 전압 } V_{TH} = 1 \text{ pu}$$

$$V_{base} = 138 \text{ kV}, \quad S_{base} = 100 \text{ MVA}, \quad I_{base} = \frac{S_{base}}{\sqrt{3} V_{base}}$$

$$(A) Z_{base} = \frac{(V_{base})^2}{S_{base}} = \frac{(138 \text{ kV})^2}{100 \text{ M}} = 190.44 \Omega$$

$$Z_{th} = 190.44 \times (0.01 + j0.1) = 1.904 + j19.044 = 19.14 \angle 84.29^\circ$$

$$(B) I_{ac \text{ rms}} = \frac{1}{|0.01 + j0.1|} = 9.95 \text{ pu}$$

$$I_{base} = \frac{100 \text{ M}}{\sqrt{3} \times 138 \text{ kV}} = 418.37 \text{ A}$$

$$I_{ac(rms)} = 418.37 \times 9.95 = 4.16 \text{ kA}$$

$$(C) \text{ 시정수 } T = \frac{L}{R} = \frac{x}{\omega R} = \frac{x}{2\pi f R}$$

$$T = \frac{0.1}{2\pi \times 60 \times 0.01} = 0.027 \text{ sec}$$

$$(D) T = 0.2 \text{ cycle} \quad \text{순시전압 (momentary)}$$

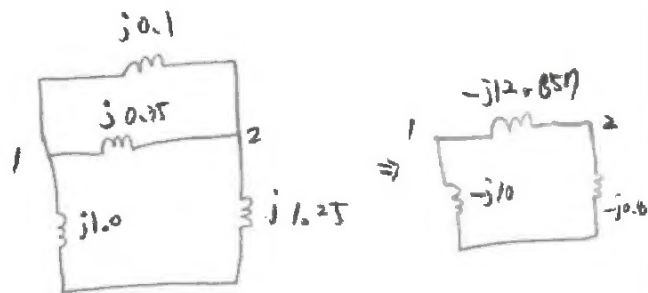
$$I_{rms} = I_{ac} \sqrt{1 + 2e^{-4\pi t / T}}$$

$$= 4.16 \text{ k} \sqrt{1 + 2e^{-4\pi \times 0.5 / 10}} = 5.98 \text{ kA}$$

$$(E) \text{ CB 3cycle 동작}$$

$$I_{rms} = 4.16 \text{ k} \sqrt{1 + 2e^{-4\pi \times 3 / 10}} = 4.25 \text{ kA}$$

4.



$$(A) Y_{bus} = \begin{bmatrix} -j12.857 & j12.857 \\ j12.857 & -j13.657 \end{bmatrix}$$

$$(B) Z_{bus} = Y_{bus}^{-1} = -0.0418 \begin{bmatrix} -j13.657 & -j12.857 \\ -j12.857 & -j13.857 \end{bmatrix}$$

$$Z_{bus} = \begin{bmatrix} j0.5709 & j0.5374 \\ j0.5374 & j0.5742 \end{bmatrix}$$

(C) 1번 bus에 서 바라봤을 때 데브닝 임피던스

$$Z_{th} = Z_{11} = \underline{j0.5709 \text{ pu}}$$

(Z_{bus} 의 Diagonal 성분은 해당 bus에서 Z_{th})



$$I = Y_{bus} V$$

$$Z_{bus} I = V$$

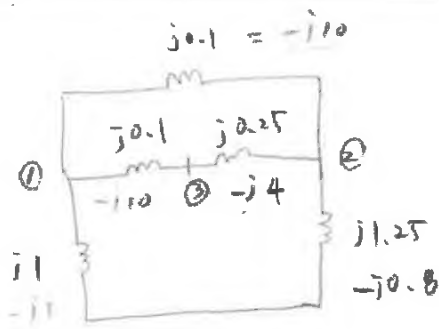
$$\begin{bmatrix} j0.5709 & j0.5374 \\ j0.5374 & j0.5742 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \end{bmatrix} = \begin{bmatrix} V_1 \\ V_2 \end{bmatrix}$$

$$\Delta V_1 = \underline{j0.5709 \text{ pu}}$$

20 || 학년도 제 학기 성적평가지

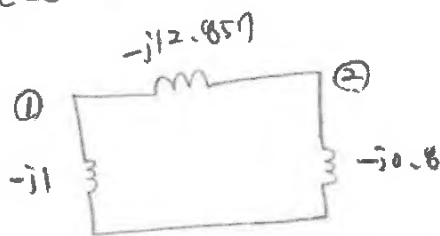
교과목명		시험일자	20 . . .	담당교수	(서명)	성적	
강좌번호		학과		학번		성명	

1.



$$(A) Y_{bus} = \begin{bmatrix} -j21 & j10 & j10 \\ j10 & -j14.8 & j4 \\ j10 & j4 & -j14 \end{bmatrix}$$

(b) 3번만 *



$$Y_{bus} = \begin{bmatrix} -j13.857 & j12.857 \\ j12.857 & -j13.657 \end{bmatrix}$$

$$\begin{aligned} (C) P_{12} &= \frac{V_1 V_2}{X_{12}} \sin(\theta_1 - \theta_2) \\ &= \frac{1 \times 1.01}{\frac{1}{12.857}} \sin(0 + \delta) \\ &= 12.857 \sin \delta \end{aligned}$$

$$\begin{aligned} (D) P_{12} &= 12.857 \sin \delta = 0.5 \\ \sin \delta &= 0.0393 \\ \delta &= \sin^{-1}(0.0393) = 2.25^\circ \end{aligned}$$

2. DC power flow

$$(A) B = \begin{bmatrix} -21 & 10 & 10 \\ 10 & -14.8 & 4 \\ 10 & 4 & -14 \end{bmatrix}$$

$$(B) B\theta = P \quad \theta_1 = 0 \text{ (1번 slack)}$$

$$\begin{bmatrix} -14.8 & 4 \\ 4 & -14 \end{bmatrix} \begin{bmatrix} \theta_2 \\ \theta_3 \end{bmatrix} = \begin{bmatrix} 1 \\ 0 \end{bmatrix}$$

$$\begin{bmatrix} \theta_2 \\ \theta_3 \end{bmatrix} = \frac{1}{956} \begin{bmatrix} -14 & -4 \\ -4 & -14.8 \end{bmatrix} \begin{bmatrix} 1 \\ 0 \end{bmatrix}$$

$$(C) \begin{bmatrix} \theta_2 \\ \theta_3 \end{bmatrix} = \begin{bmatrix} -0.0093 \\ -0.0209 \end{bmatrix} \text{ rad}$$

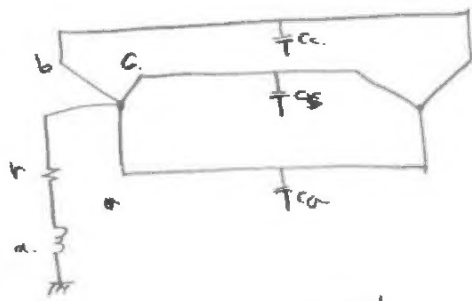
$$\begin{aligned} (D) P_{12} &= \frac{1}{X_{12}} (\theta_1 - \theta_2) \\ &= \frac{1}{0.1} (0 + 0.0093) \\ &= 0.093 \text{ pu} \end{aligned}$$

$$P_{12} = 0.093 \text{ pu} \quad (1 \rightarrow 2)$$

$$S_{base} = 100 \text{ MVA}$$

$$P_{12} = 0.093 \times 100 \text{ M} = 9.3 \text{ MW} \quad (1 \rightarrow 2)$$

3. 중성점 전압 전압



200 kV, 154 kV

$$(A) \quad C_a = 0.0045 \times 200 = 0.9 \mu F$$

$$C_b = 0.0048 \times 200 = 0.96 \mu F$$

$$C_c = 0.005 \times 200 = 1 \mu F$$

$$E_n = \frac{\sqrt{C_a(C_b - C_c) + C_b(C_c - C_a) + C_c(C_a - C_b)}}{C_a + C_b + C_c} \times \frac{V}{\sqrt{3}}$$

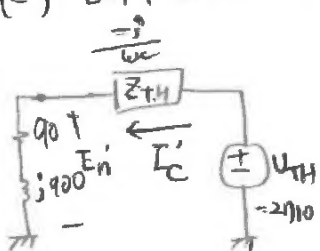
$$= 0.0305 \times \frac{154k}{\sqrt{3}} = 2710 V$$

$$(B) \quad I_c = \omega C E = 120\pi \times (0.9 + 0.96 + 1) \mu \times \frac{154k}{\sqrt{3}} = 95.86 A$$

$$E_L = \frac{E}{|1 + jx|} = \frac{154k}{\sqrt{90^2 + 900^2} \sqrt{3}} = 98.3$$

$$\text{상차} P = \frac{E_L - E_c}{I_c} \times 100 = \frac{98.3 - 95.86}{95.86} \times 100 = 2.55\%$$

(C) 컨버터 정류회 중성점 전압



$$I'_c = \frac{2710}{90 + j900 + \frac{-j}{2\pi \times 2.86 \times 10^6}} = 28.8 \angle 16.96^\circ A$$

$$E'_n = 28.8 \angle 16.96^\circ \times (90 + j900) = 26.05 kV$$

$$4. \quad V_{LL} = 20 kV, \quad R = 2 \Omega, \quad X = 9.5 \Omega$$

$$(A) \quad I_{ac rms} = \frac{V}{Z} = \frac{20k}{|2 + j9.5|}$$

$$= 2060.1 A$$

$$(B) \quad T = \frac{L}{R} = \frac{X}{\omega R} = \frac{X}{2\pi f R}$$

$$= \frac{9.5}{120\pi \times 2} = 0.0126 \text{ sec}$$

$$(C) \quad Z = 0.5 \text{ cycle}$$

$$i_{rms}(Z) = I_{ac} \sqrt{1 + 2e^{-4\pi Z / (\frac{X}{R})}}$$

$$= 2.06k \sqrt{1 + 2e^{-4\pi \times 0.5 \times 0.2105}}$$

$$= 2.5 kA$$

$$(D) \quad Z = 3 \text{ cycle}, \quad CB \text{ 동작 전압} = i_{rms}(Z)$$

$$i_{rms}(Z) = 2.06k \sqrt{1 + 2e^{-4\pi \times 3 \times 0.2105}}$$

$$= 2.061 kA$$